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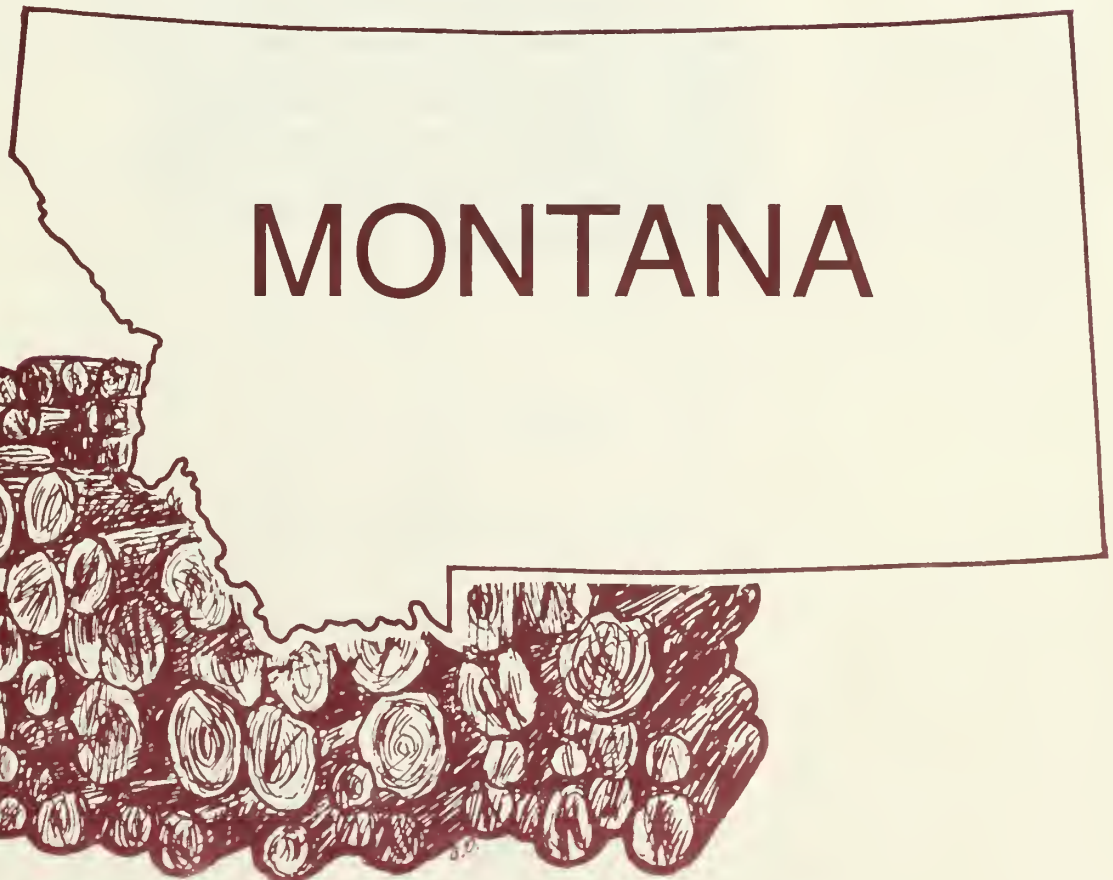
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# Montana's 1988 Fuelwood Harvest

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## THE AUTHOR

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## ACKNOWLEDGMENTS

We appreciate the cooperation of the following groups in supplying data for this report:

1. The owners and operators of Montana's primary wood processing industries.
2. The commercial fuelwood operators of Montana who responded to our inquiries.
3. The members of the 400 households sampled in the State who provided us data.
4. The Montana Department of State Lands, Forestry Division; the staffs of the many Ranger Districts and National Forests in Montana; and the Northern Region, Forest Service, U.S. Department of Agriculture, for supplying us with information and referrals.

## RESEARCH SUMMARY

The estimated fuelwood harvest in Montana in 1988 was 273,440 cords (21.9 million cubic feet). The fuelwood harvest volume was 10 percent as large as the volume of sawlogs and other industrial roundwood products harvested. The volume of live timber trees harvested for fuelwood was 19,400 cords (1,548,800 cubic feet), less than 1 percent of the total harvest of roundwood products in 1988.

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## BACKGROUND

The Forest Survey unit at the Intermountain Research Station is charged with making comprehensive surveys and analyses of the forest resource situation in the Rocky Mountain States (fig. 1). Periodic annual estimates and descriptions of wood harvests are part of this mission.

Harvest data for calendar year 1988 were collected in Montana in 1989 to coincide with the forest inventory of that State. The inventory provided the data to estimate and describe the volume, growth, and mortality of the forest's trees. The harvest data are used to assess and describe the changes in the State's inventory due to logging and related activities. The fuelwood harvest, one segment of tree harvesting, is the focus of this report.

## SURVEY PROCEDURES

Fuelwood harvest data were collected from two distinct groups—commercial operators and households. Commercial operators harvest fuelwood and other roundwood products to sell to consumers or retail outlets and comprise multiproduct roundwood harvesters and loggers who mostly harvest fuelwood. Members of households harvest fuelwood for personal use. These two populations were surveyed in different ways.

### Commercial Operators

We canvassed primary wood processing plants, such as sawmills; and individuals and businesses identified as potential commercial operators from



Figure 1—Rocky Mountain States.

bidders lists supplied by National Forest and Montana Department of State Lands, Forestry Division personnel.

Primary wood processing plants reported receiving no fuelwood in 1988, although some was generated as mill residue, which is not included in fuelwood harvest estimates.

We sent approximately 356 questionnaires to potential commercial operators. Twenty-six reported harvesting, 38 reported no harvest, 38 were returned as undeliverable, 6 reported as more complex operations to be included in the primary wood processing plant canvass, and 248 did not respond.

## Personal Use Fuelwood Harvest

Personal use fuelwood harvest estimates were obtained by surveying residents of 400 households in Montana. The population sampled consisted of all residential listings in all Montana telephone books. A random number generator was used to select the sample, which was distributed throughout the telephone books in proportion to the number of households within the books. Copies of the program

used to select the actual sample are available from Gordon D. Booth, Statistics/Computer Science Group, Intermountain Research Station.

Of the 400 households surveyed in the State, 72 reported fuelwood harvests for 1988. The other 328 reported not harvesting.

## RESULTS

In 1988 an estimated 273,440 cords, or over 21.9 million cubic feet, of fuelwood were harvested in Montana (tables 1 to 3). (The fuelwood volume was reported in cords and converted to cubic feet using 80 ft<sup>3</sup>/cord, the standard U.S. Forest Service conversion rate.) The amount of fuelwood cut equals about 10 percent of the 1988 Montana harvest of sawlogs and other industrial roundwood products (McLain and Keegan in preparation).

The 1988 fuelwood harvest, although a substantial proportion of total roundwood production in Montana, was not a significant drain on the growing-stock inventory of Montana's forests. Nor does it appear to have been in much direct competition with the forest products industry for wood fiber.

Table 1—Fuelwood harvest by county group and owner, Montana, 1988

| County group       | Owner           |               |        |         | Total <sup>1</sup> |
|--------------------|-----------------|---------------|--------|---------|--------------------|
|                    | National Forest | National Park | State  | Private |                    |
|                    | <i>Cords</i>    |               |        |         |                    |
| 1 Northwest        | 23,804          | —             | 7,625  | 67,108  | 98,537             |
| 2 East             | 7,245           | —             | —      | 39,654  | 46,899             |
| 3 West             | 9,236           | —             | —      | 32,790  | 42,026             |
| 4 West central     | 20,205          | —             | 3,813  | 19,091  | 43,109             |
| 5 Southwest        | 21,397          | 30            | —      | 21,442  | 42,869             |
| Total <sup>1</sup> | 81,887          | 30            | 11,438 | 180,085 | 273,440            |

<sup>1</sup>Data may not sum to totals due to rounding or truncating.

**Table 2—Fuelwood harvest by species and owner, Montana, 1988**

| Species                      | Owner             |                 |        |         | Total <sup>1</sup> |
|------------------------------|-------------------|-----------------|--------|---------|--------------------|
|                              | National Forest   | National Park   | State  | Private |                    |
|                              | ----- Cords ----- |                 |        |         |                    |
| True fir                     | 796               | —               | —      | 1,525   | 2,321              |
| Larch                        | 8,820             | —               | —      | 25,929  | 34,749             |
| Lodgepole pine               | 53,395            | 30              | 7,625  | 53,879  | 114,929            |
| Ponderosa pine               | 9,533             | —               | —      | 34,697  | 44,230             |
| Douglas-fir                  | 7,818             | —               | 3,813  | 19,064  | 30,695             |
| Cottonwood                   | 1,525             | —               | —      | 32,599  | 34,124             |
| Aspen                        | —                 | —               | —      | 8,388   | 8,388              |
| Other hardwoods <sup>2</sup> | —                 | —               | —      | 4,004   | 4,004              |
| Total <sup>1</sup>           | 81,887            | <sup>3</sup> 30 | 11,438 | 180,085 | 273,440            |

<sup>1</sup>Data may not sum to totals due to rounding or truncating.

<sup>2</sup>Maple, elm, and ash.

<sup>3</sup>Result of maintenance, cleanup, and debris disposal.

**Table 3—Fuelwood harvest by county group and species, Montana, 1988**

| Species                      | County group   |           |           |                   |                | Total <sup>1</sup> |
|------------------------------|----------------|-----------|-----------|-------------------|----------------|--------------------|
|                              | Northwest<br>1 | East<br>2 | West<br>3 | West central<br>4 | Southwest<br>5 |                    |
| ----- Cords -----            |                |           |           |                   |                |                    |
| True fir                     | 2,295          | —         | 9         | 17                | —              | 2,321              |
| Larch                        | 32,818         | —         | 1,931     | —                 | —              | 34,749             |
| Lodgepole pine               | 48,172         | 6,100     | 16,065    | 19,452            | 25,140         | 114,929            |
| Ponderosa pine               | 10,676         | 11,821    | 5,338     | 13,345            | 3,050          | 44,230             |
| Douglas-fir                  | 4,576          | —         | 11,820    | 10,295            | 4,004          | 30,695             |
| Cottonwood                   | —              | 21,161    | 6,863     | —                 | 6,100          | 34,124             |
| Aspen                        | —              | 3,813     | —         | —                 | 4,575          | 8,388              |
| Other hardwoods <sup>2</sup> | —              | 4,004     | —         | —                 | —              | 4,004              |
| Total <sup>1</sup>           | 98,537         | 46,899    | 42,026    | 43,109            | 42,869         | 273,440            |

<sup>1</sup>Data may not sum to totals due to rounding or truncating.

<sup>2</sup>Maple, elm, and ash.

This is because most of the fuelwood harvest was dead trees or nontimber trees such as elm, ash, and mountain maple.

The fuelwood harvest of standing live trees of timber species, those tree species traditionally harvested for lumber products, was estimated as only 19,400 cords, 7.0 percent of the total fuelwood harvest, less than 1 percent of the roundwood harvest of live trees and the total 1988 roundwood production (fig. 2). Of the remaining 254,000 cords of fuelwood harvested, 250,000 were from dead trees of timber species, and 4,000 were from nontimber trees.

Over 99 percent of the fuelwood was cut for personal consumption. Commercial operators reported harvesting only 1,600 cords.

Lodgepole pine (*Pinus contorta*) accounted for 42 percent of the harvest with 115,000 cords, followed by ponderosa pine (*P. ponderosa*), larch (*Larix occidentalis*), cottonwood (*Populus* spp.), and Douglas-fir (*Pseudotsuga menziesii*) (tables 2 and 3, fig. 3).

We estimate that 66 percent of the fuelwood harvest came from private lands, that National Forests provided 30 percent, and State lands 4 percent (tables 1 and 2). Our estimate of 82,000 cords harvested from Montana's National Forests in 1988 differs from that of the Forest Service's Northern Region. However, their estimate falls within our 95 percent confidence interval (see the subsequent section, Standard Error).

The estimated harvest from the northwest county group was twice that of any one of the other four county groups (tables 1 and 3, fig. 4).

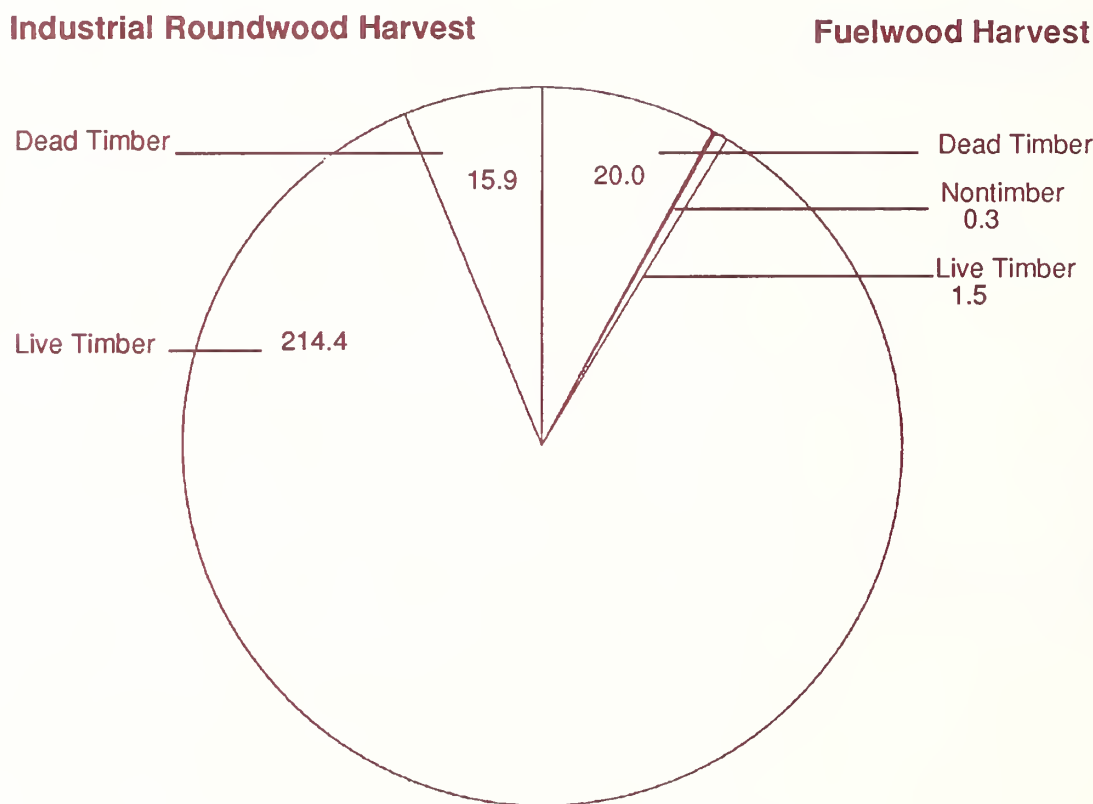


**Figure 2**—A comparison of the tree class composition of the fuelwood harvest and the industrial roundwood harvest in Montana, 1988, in million cubic feet.

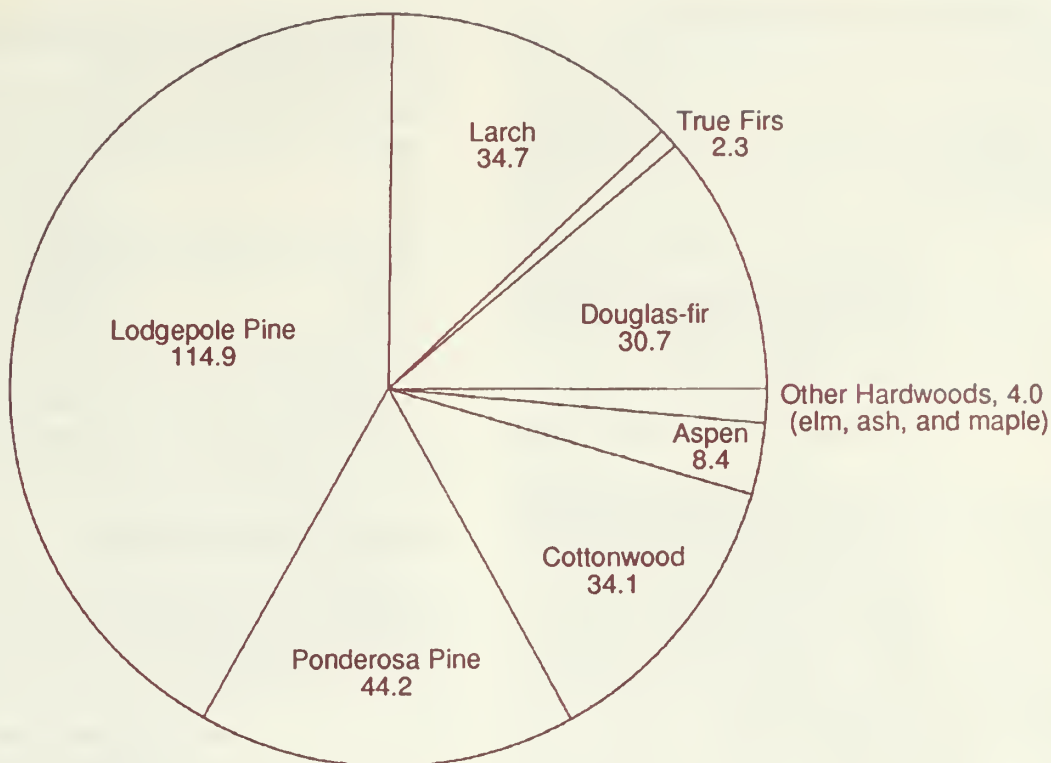


**Figure 3**—Species distribution of the fuelwood harvest in Montana, 1988, in thousand cords.

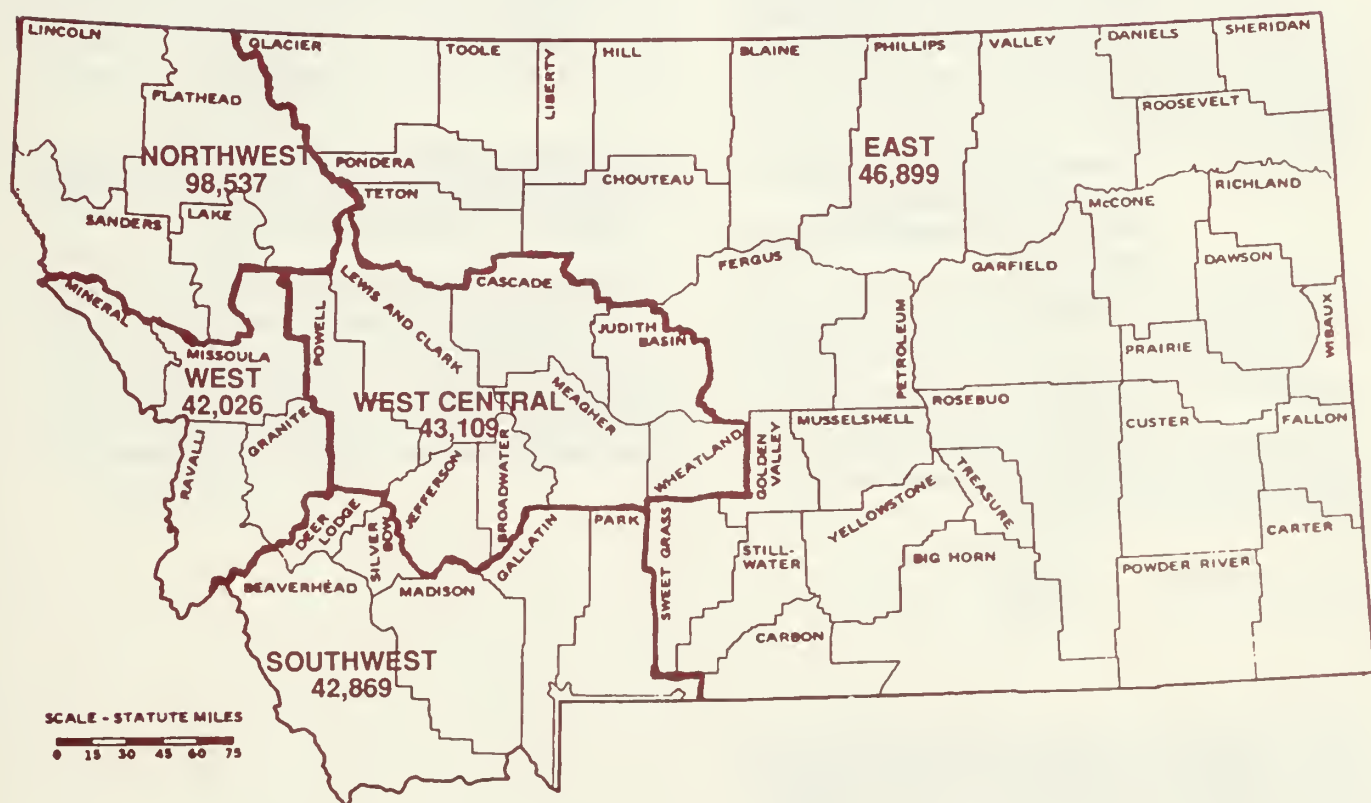


**Figure 4**—Montana fuelwood harvest by county group in cords, 1988.

## EXPANSION OF HOUSEHOLD SAMPLE

The following procedure was used to expand the sample statistics to obtain the estimate of the total volume of fuelwood harvested by all the households in Montana.

|             |    |                                                                                                                                                                       |
|-------------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| $n$         | =  | number of households in sample                                                                                                                                        |
| $nc$        | =  | number of households in sample that harvested fuelwood                                                                                                                |
| $\Sigma X$  | =  | reported harvest by $nc$ in cords                                                                                                                                     |
| $\bar{X}$   | =  | $\frac{\Sigma X}{nc}$ ; mean harvest, in cords, by $nc$                                                                                                               |
| $N$         | =  | estimated number of households in all Montana telephone books                                                                                                         |
| $NC$        | =  | $N \left(\frac{nc}{n}\right)$ ; estimated number of households in Montana phone books cutting fuelwood                                                                |
| $VOL$       | =  | estimated volume of fuelwood harvested by $N$                                                                                                                         |
| $VOL$       | =  | $NC (\bar{X})$                                                                                                                                                        |
| $P$         | =  | Bureau of Census estimate of the number of households in Montana                                                                                                      |
| $K$         | =  | population adjustment factor; used to expand the estimate of harvest by the households in the telephone books to the estimate of harvest by all households in Montana |
| $K$         | =  | $\frac{P}{N}$                                                                                                                                                         |
| $TOT VOL^1$ | =  | estimate of the total volume harvested by households in Montana for personal consumption                                                                              |
| $TOT VOL$   | =  | $VOL(K)$                                                                                                                                                              |
|             | or |                                                                                                                                                                       |
| $TOT VOL$   | =  | $\frac{P}{n}(\Sigma X)$                                                                                                                                               |

The volumes reported in the cells of tables 1 through 3 were found by multiplying reported volumes by the expansion factor:

$$\text{Expansion factor} = \frac{TOT VOL}{\Sigma X} = \frac{P}{n}$$

For the 1988 harvest of fuelwood by households, the following were computed:

|            |   |               |
|------------|---|---------------|
| $n$        | = | 400           |
| $nc$       | = | 72            |
| $\Sigma X$ | = | 360.5         |
| $\bar{X}$  | = | 5.00694       |
| $N$        | = | 301,005       |
| $NC$       | = | 54,181        |
| $VOL$      | = | 271,280       |
| $P$        | = | 305,000       |
| $K$        | = | 1.01327       |
| $TOT VOL$  | = | 274,881 cords |

$$\text{Expansion factor} = 762.5$$

## STANDARD ERROR

The variances, standard errors, and confidence intervals of the estimates of the total volumes harvested by households were found as follows:

$VAR$  = variance of the volume harvested by the sample; computed using the number of households that harvested ( $nc$ )

$VAR TOT VOL$  = variance of the total volume

$$VAR TOT VOL = \left[ \frac{(\bar{X})^2(NC)(N-NC)}{n} + \frac{(NC)^2(VAR)}{nc} \right] (K^2)$$

Std. error  $TOT VOL$  = standard error of the total volume  
 $= \sqrt{VAR TOT VOL}$

For 95 percent confidence interval of the estimate of the total volume:

$$TOT VOL \pm 2 (\text{std. error } TOT VOL)$$

For the 1988 harvest of fuelwood by households, the following statistics were calculated:

$$VAR TOT VOL = 1,287,140,000 \text{ cords}$$

$$\text{Std. error } TOT VOL = 35,877 \text{ cords}$$

$$95 \text{ percent confidence interval} = \pm 71,754 \text{ cords} \\ (\pm 26.1 \text{ percent})$$

<sup>1</sup>This is not necessarily the volume harvested in Montana. Some of the fuelwood harvest reported by the population sampled took place in Idaho. These "outside" harvest volumes were included in calculations of the mean ( $\bar{X}$ ) and are thus included in all computations involving  $\bar{X}$ . This does not, however, affect the calculation of the harvest volume in Montana.

## TERMINOLOGY

*Commercial fuelwood operators*—Those who harvest fuelwood to sell to dealers or consumers. Includes loggers who harvest fuelwood along with sawlogs and other products.

*Cord*—A pile of stacked wood equivalent to 128 cubic feet of wood and air space having standard dimensions of 4 by 4 by 8 feet.

*Forest lands*—Lands at least 10 percent stocked by forest trees of any size, including lands that formerly had such tree cover and that will be naturally or artificially regenerated. The minimum area for classification of forest land is 1 acre. Roadside, streamside, and shelterbelt strips of timber must have a crown width at least 120 feet wide to qualify as forest land. Unimproved roads and trails, streams, and clearings in forest areas are classified as forest if less than 120 feet wide.

*Fuelwood production*—Fuelwood harvest. The fuelwood portion of roundwood production. The fuelwood volume of roundwood products.

*Growing-stock (volume)*—The net cubic-foot volume of wood in live trees from a stump 1 foot high to a 4.0-inch diameter top, outside bark. Such trees must be timber trees, those traditionally harvested for lumber products (excludes pinyon, juniper, ornamentals, and fruit trees), must have a central stem at least 5 inches in diameter at breast height (d.b.h.), and must meet specified standards of quality and vigor, thus excluding cull trees.

*Industrial roundwood production*—The conversion of trees into industrial roundwood products. The volume of industrial roundwood products resulting from harvest.

*Industrial roundwood products, or industrial wood products, or industrial roundwood, or timber products*—Includes sawlogs, pulpwood bolts or logs, houselogs, veneer logs, utility poles, building poles, corral poles, posts, excelsior bolts, ties, mine timbers, and pilings. Does not include fuelwood.

*Nonforest lands*—Lands not qualifying as forest lands. In this publication, references to nonforest lands mean orchards, parks, urban areas, and windbreaks.

*Nontimber trees*—Trees other than timber trees. Nontimber tree species are pinyon, juniper, and all hardwoods except cottonwood and aspen.

*Primary wood processing industry (or plants)*—Generally, includes sawmills; fiber board, veneer, and plywood plants; pulp mills; houselog plants; post and pole yards; post and pole treating plants, excelsior plants; tie yards; and producers of pilings.

*Roundwood production*—The production of industrial roundwood and fuelwood. The conversion of trees into roundwood products. The volume of roundwood products resulting from harvest.

*Roundwood products, or roundwood*—Includes sawlogs, pulpwood bolts or logs, houselogs, veneer logs, utility poles, building poles, corral poles, posts, excelsior bolts, ties, mine timbers, pilings, and fuelwood. Differs from industrial roundwood products because roundwood products include fuelwood.

*Timber production*—Timber products; same as industrial roundwood products or industrial roundwood production. Does not include fuelwood.

*Timber species*—Those tree species traditionally harvested for lumber products, such as ponderosa pine, Douglas-fir, lodgepole pine, cottonwood, and aspen. Excludes pinyon, juniper, and miscellaneous hardwoods such as oaks, shade trees, ornamentals, and fruit trees.

## REFERENCE

McLain, William H.; Keegan, Charles E., III. [In preparation]. Montana's timber production and mill residue, 1988. Resour. Bull. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station.

## APPENDIX: MONTANA DIRECTORY OF COMMERCIAL FIREWOOD CUTTERS

| County     | Firewood cutter                                                                                                                                       | County          | Firewood cutter                                                                                                                                                                                           |
|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Beaverhead | Tucker's Repair<br>Box 57<br>Wisdom, MT 59761<br>406-689-3198<br>Larry Tucker, Owner                                                                  | Lewis and Clark | Backwoods Products<br>3870 Valley Dr.<br>Helena, MT 59601<br>406-227-6198<br>Mike Shelton, Owner                                                                                                          |
| Cascade    | L. R. Cunningham<br>500 Riverview Dr. NE<br>Great Falls, MT 59404                                                                                     | Lewis and Clark | Banner Construction<br>115 N. Davis<br>Helena, MT 59601<br>John R. Coleman, Mgr.                                                                                                                          |
| Flathead   | TNT Firewood<br>2170 Airport Rd.<br>Kalispell, MT 59901<br>406-756-1109<br>Thomas M. Shouler, Owner                                                   | Lincoln         | Ekholt Logging<br>Box 378<br>Eureka, MT<br>Location: Fortine, MT<br>406-882-4621<br>Gene Ekholt, Owner                                                                                                    |
| Flathead   | Terry Knutson<br>1308 Swan Highway<br>Bigfork, MT 59911<br>406-837-5802                                                                               | Missoula        | James H. Davis Logging<br>1262 S. Third<br>Missoula, MT 59801<br>Locations: Drummond,<br>Lincoln, and Missoula<br>406-549-8788<br>800-348-7098, Ext. 1029<br>(Answering Service)<br>James H. Davis, Owner |
| Flathead   | Jerry Waller<br>4375 Hwy 2 W.<br>Kila, MT 59920<br>406-755-4206                                                                                       |                 |                                                                                                                                                                                                           |
| Gallatin   | Andesite Enterprises<br>P.O. Box 456<br>Big Sky, MT 59716<br>406-995-4140                                                                             | Mineral         | Dave McManus and<br>Bob Miles<br>P.O. Box 753<br>Superior, MT 59872<br>406-822-4026<br>406-822-4530                                                                                                       |
| Gallatin   | High Country Firewood<br>54740 Gallatin Rd.<br>Gallatin Gateway, MT 59730<br>Location: Big Sky, MT<br>406-995-4856<br>Tom Woodruff, Owner             | Mineral         | Dave McManus<br>Box 308<br>Superior, MT 59872<br>406-822-4026                                                                                                                                             |
| Gallatin   | Yellowstone Firewood Co.<br>Box 385<br>West Yellowstone, MT 59753<br>Location: 22 Hayden<br>West Yellowstone, MT<br>406-646-7515<br>Billy Lopp, Owner | Park            | Menuey Timbering Outfit<br>Box 1098<br>Cooke City, MT 59020<br>Location: 3 miles east of<br>Cooke City on U.S. 212<br>406-838-2392<br>Mitch Menuey, Owner                                                 |
| Jefferson  | B. L. Cooper Inc.<br>Box C<br>Boulder, MT 59632<br>Location: 1 mile north<br>of Boulder<br>406-225-3886<br>Barton L. Cooper, Owner                    |                 |                                                                                                                                                                                                           |



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Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain  
Research Station. 8 p.

Highlights the 1988 harvest of fuelwood in Montana by commercial fuelwood  
harvesters and those cutting for home consumption. Presents harvest volumes  
by species, county, and owner. Lists a directory of commercial fuelwood harvest-  
ers and describes the methods of data collection and compilation.

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KEYWORDS: fuelwood, firewood

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